



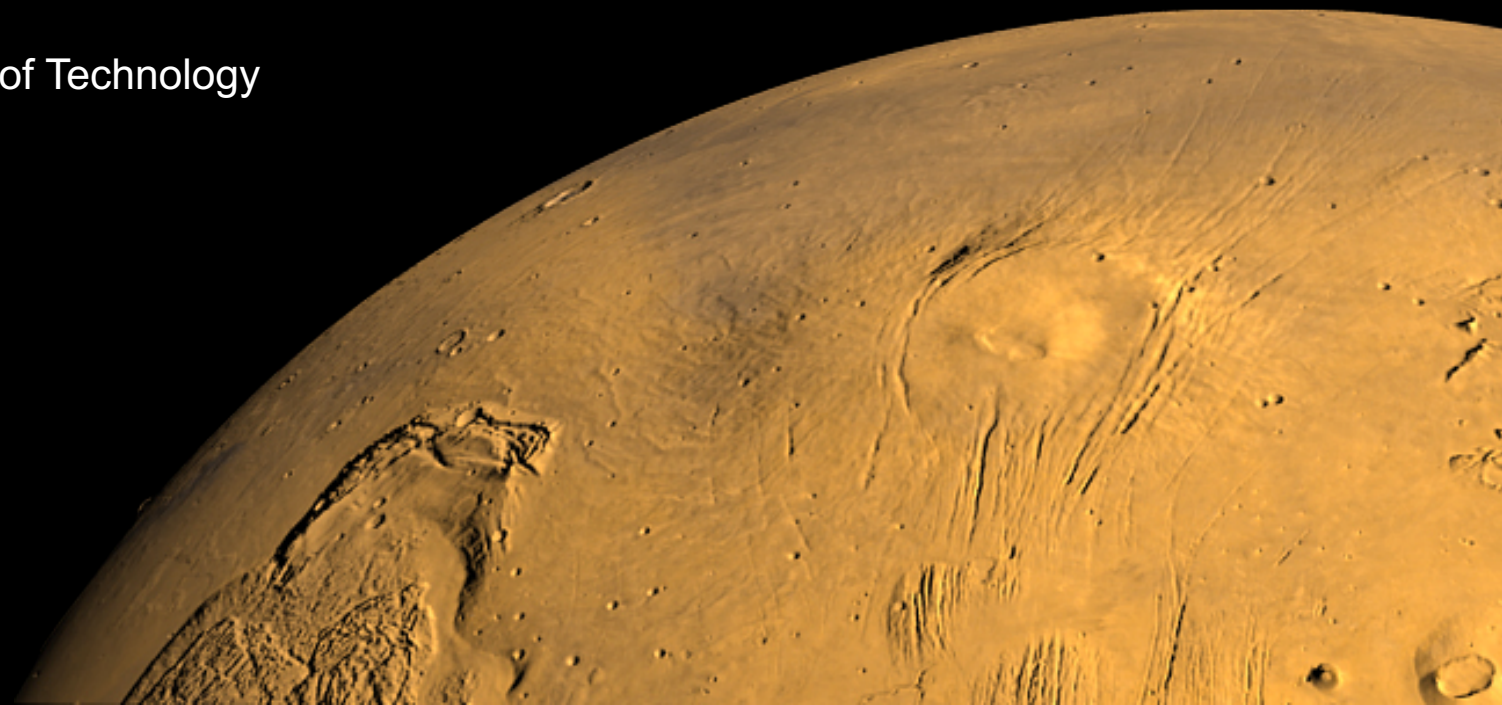
Jet Propulsion Laboratory
California Institute of Technology

Mars Relay Communications

Chad Edwards

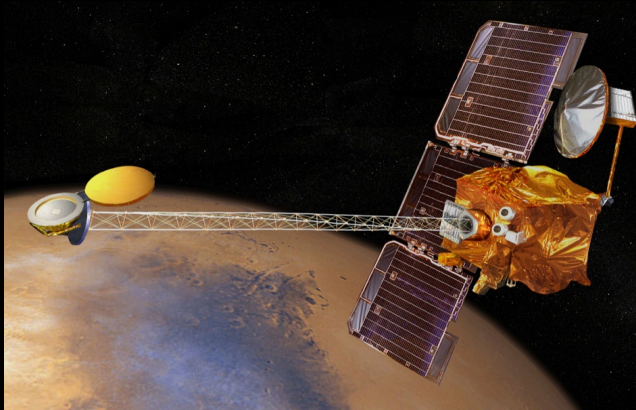
Jet Propulsion Laboratory, California Institute of Technology

March 4, 2019

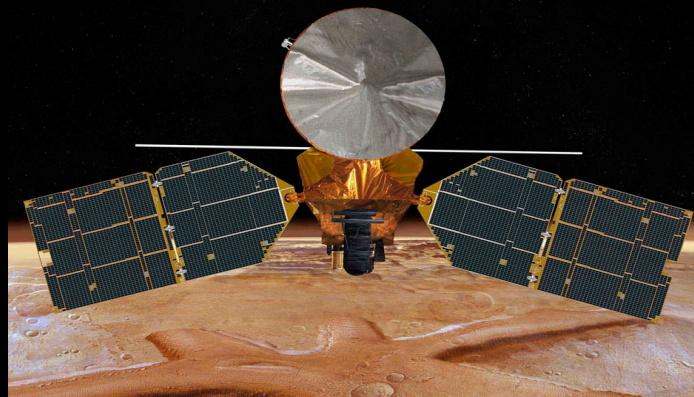


Current Mars Relay Network

Odyssey (2001)



MRO (2005)



ESA ExoMars
Trace Gas Orbiter (2016)



Mars Express (2003)

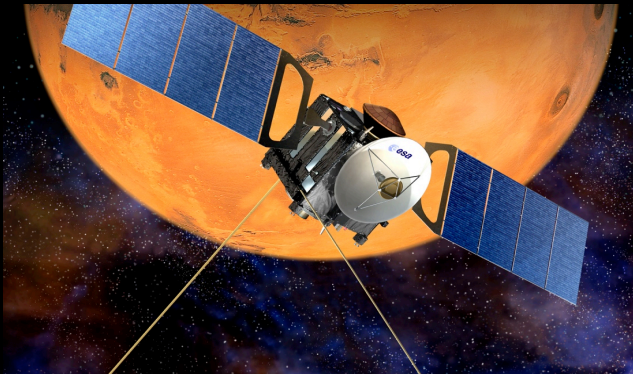
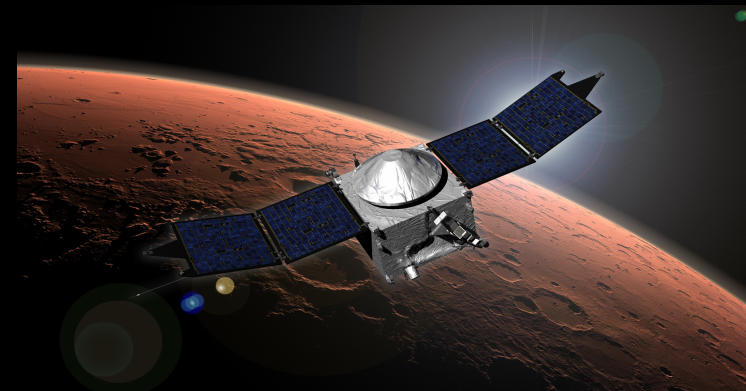
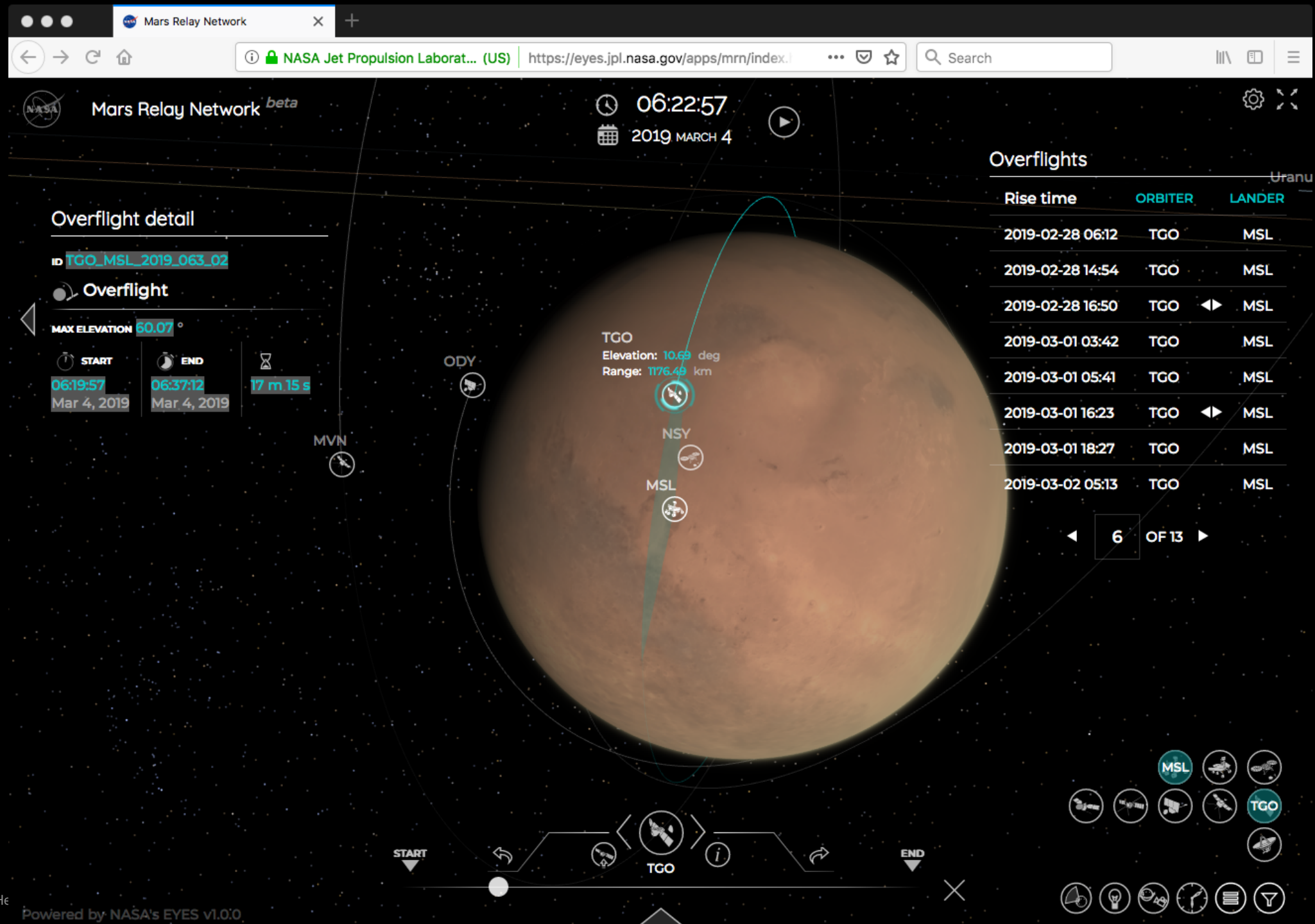


Image: ESA

MAVEN (2013)







Curiosity

Jan 15, 2019
Vera Rubin Ridge
Gale Crater

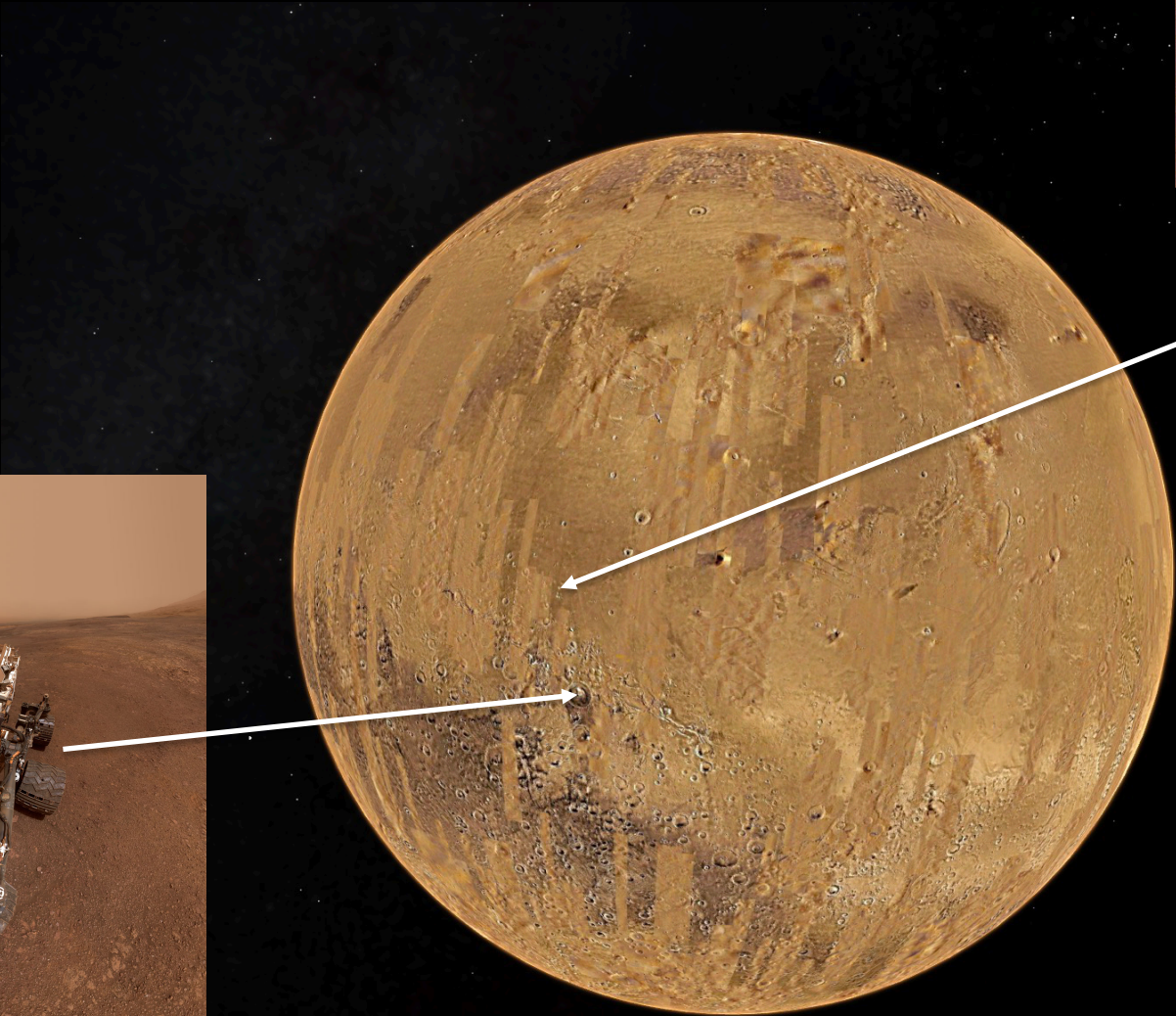
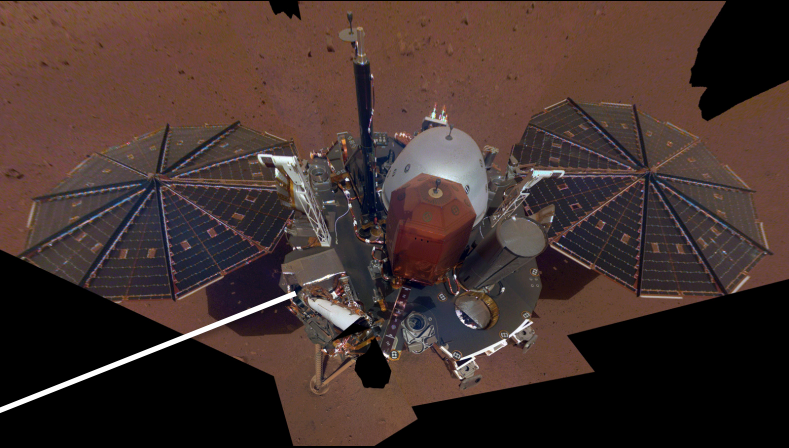


Image NASA / USGS
ESA / DLR / FU Berlin (G.Neukum)



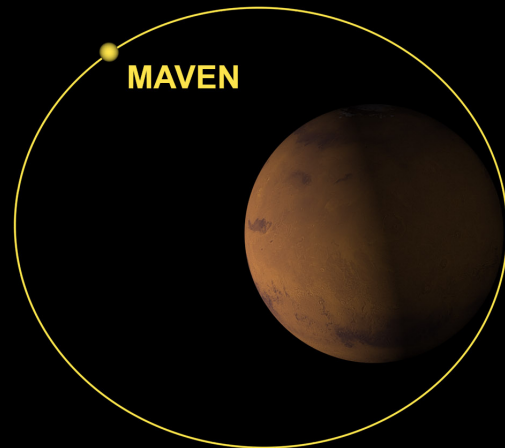
InSight

Dec 6, 2018
Elysium Planitia

Google Earth

MAVEN Orbit Evolution

January 2019



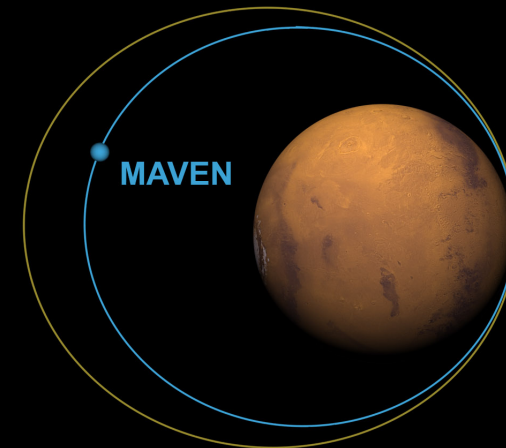
Science Orbit
~ 6,200 x 150 km
Orbital Period: 4.5 hr



Aerobraking
Campaign

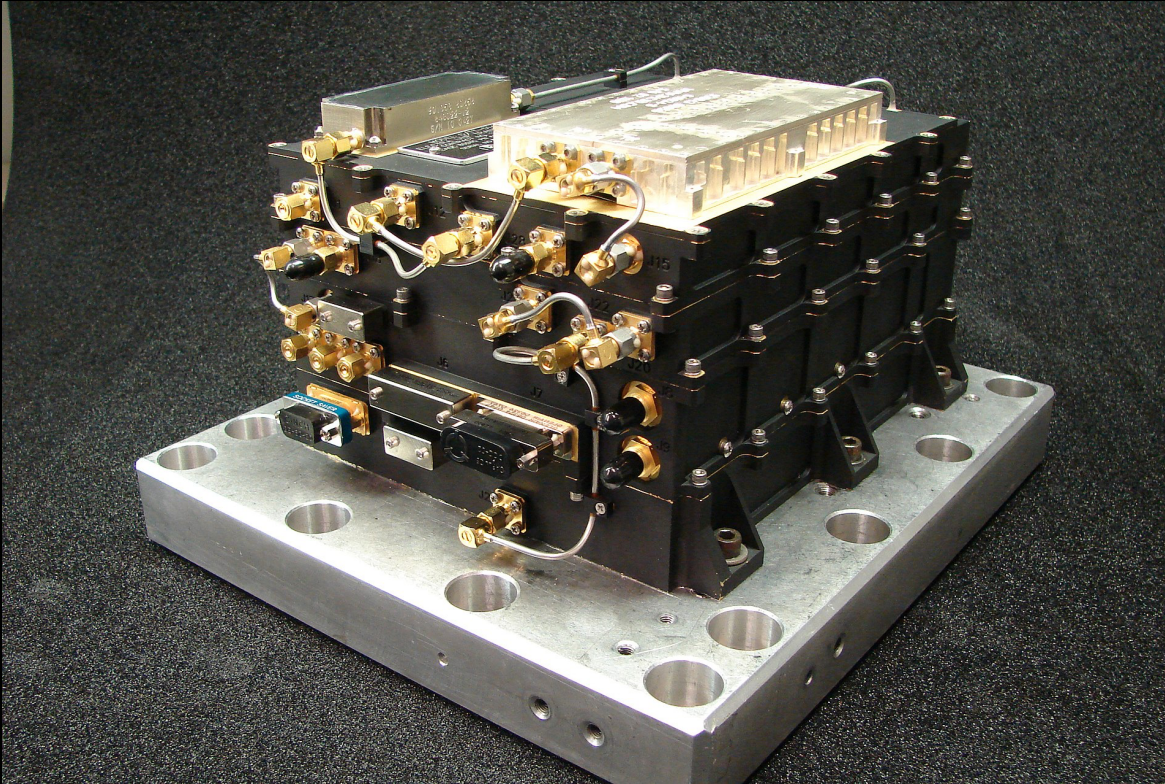
Deep Dip Orbits
~ 125 km

May 2019



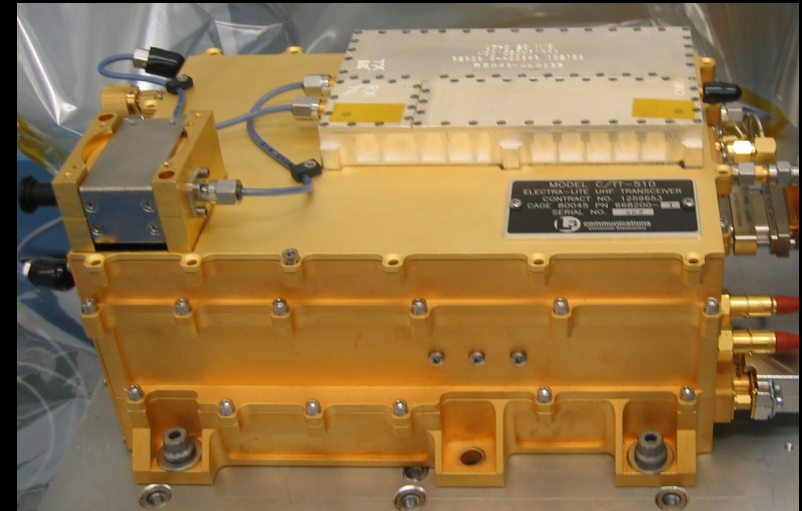
Science & Relay Orbit
~ 4,500 x 150 km
Orbital Period: 3.5 hr

Electra and Electra-Lite UHF Transceivers



Electra UHF Transceiver
(5.0 kg)

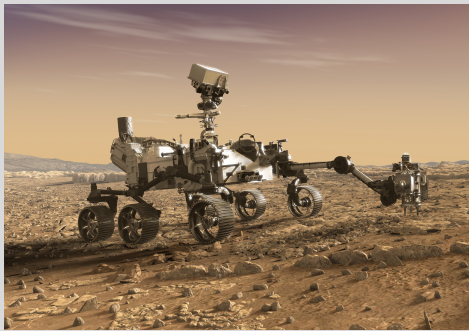
- *Software-defined radio architecture*
- *Frequency-agile (390-450 MHz)*
- *CCSDS Prox-1 compliant*
- *Data rates up to 2 Mb/s*
- *Adaptive data rate capability*
- *Low-Density Parity Check capability*
- *Full-spectrum (open-loop) recording*



Electra-Lite UHF Transceiver
(3.5 kg)

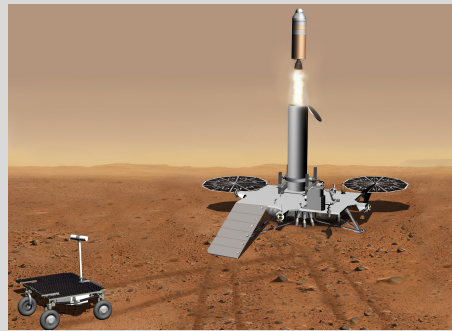
Notional Mars Sample Return Architecture

- Three flight elements plus one ground element
 - Limits the cost, mass/volume, and technical challenges of each flight element



**Sample Caching
Rover
(Mars 2020)**

- *Sample acquisition and caching*



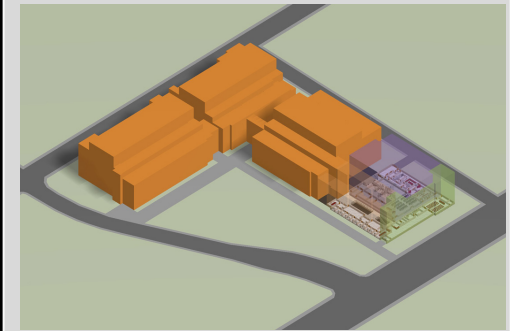
**Sample Retrieval
Lander***

- *Fetch Rover*
- *Orbiting Sample container (OS)*
- *Mars Ascent Vehicle*



**Earth Return
Orbiter***

- *Rendezvous and On-Orbit Capture System*
- *Earth Entry Vehicle*

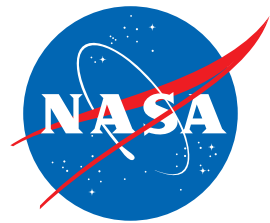


**Mars Returned Sample
Handling***

- *Sample Receiving Facility*
- *Curation*
- *Sample science investigations*

Flight Elements

Ground Element



Jet Propulsion Laboratory
California Institute of Technology